

M.S. Ramaiah University of Applied Sciences

New BEL Road, MSR Nagar, Bangalore – 560054



**RAMAIAH
UNIVERSITY**
OF APPLIED SCIENCES

PO, PSO, PEO & CO

Programme: M. Sc. in Biotechnology

Programme Code: 091

Programme Outcome (PO)

Programme Specific Outcome (PSO)

Program Educational Objectives (PEO)

Course Outcomes (CO)

Registrar

M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Approved in 23rd ACM (Resolution 23.05) held on 15th July 2021

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Faculty of Life and Allied Health Sciences (FLAHS)

Programme Name: M. Sc. in Biotechnology

Programme Outcomes (POs)

- PO 1. **Technical Knowledge:** Demonstrate in-depth knowledge of the scientific fundamentals and the modern technical knowledge needed to support Biotechnology research activities.
- PO 2. **Design/Development solution:** Identify, analyse and understand the problems related to life sciences and find valid conclusions with basic knowledge acquired in the fields.
- PO 3. **Multidisciplinary approach:** Correlate how different sub-systems co-operate with each other into current research and development in the respective fields.
- PO 4. **Entrepreneurship skills:** Analyze manufacturing constituents and complete systems for relevant products and to enable enterprising skills for competing globally.
- PO 5. **Societal Responsibility:** Innovate and develop sustainable solutions and understand their effect on society and environment.
- PO 6. **Leadership and Ethics:** Apply professional Ethics, Leadership and consensus building skills relevant to the aspects of business enterprise in the respective fields.
- PO 7. **Lifelong learning:** Adopt changes and advancements in science and engage in independent learning.
- PO 8. **Communication:** Communicate the information effectively in scientific writing and oral presentation.

Programme Specific Outcomes (PSO)

- PSO 1: Understand the foundational concepts of biotechnology, and how these impact life science research and development in the diverse fields that span healthcare and agriculture.
- PSO 2: Design, perform, and analyze results of experiments using basic molecular biology methodologies and recombinant DNA techniques, including agarose and polyacrylamide gel electrophoresis, restriction enzyme digestion, bacterial transformations, plasmid DNA protein expression, PCR, and tissue culture.
- PSO 3: Apply various facets of biotechnological approaches with strong ethical and social responsibilities in bringing solution for human health, agriculture and other welfare.
- PSO 4: Students will be able to gain hands on experience in basic and advanced techniques in biotechnology research and get trained effective scientific communication. This experience would enable them to begin a career in industry as well as in research laboratories or to innovate new start up with their entrepreneurship skills.


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Programme Educational Objectives (PEO):

The objectives of the programme are to enable the students to:

- PEO 1: To update, extend and deepen students' knowledge through a flexible, research-intensive program to academia and industry requirements.
- PEO 2: To enhance career opportunities in industry, clinical settings both locally and globally or as a preparation for further higher education through in-house state of the art laboratory exposures and outbound dissertation activities fostering Global Competencies among Students.
- PEO 3: To enable critical thinking and full-fledged grasp of essential aspects of bioethics inculcating a Value System among Students.
- PEO 4: To enrich the global think tanks with right mixes of innovative ability, existing policies at generating and safeguarding the product of their intellect, equipped with entrepreneurship abilities contributing to self and national development.

Course Outcomes (COs)

Course Title & Code: Fundamentals of Cell Biology (BTD501A)

After undergoing this course students will be able to:

- CO-1. Explain the bimolecular composition, organization and function of different organelles like cell membrane systems, nucleus, mitochondria, peroxisomes, ER, chloroplast, Golgi complex
- CO-2. Enumerate the differences between the integral and peripheral proteins of membrane, active and passive transport across membrane, intercellular and intracellular signaling in apoptosis
- CO-3. Delineate the involvements of cytoskeleton in cellular motility, mitochondria in energy production, hormones in maintaining homeostasis, signal receptors in growth and development
- CO-4. Explain the internal and external factors that influence the cell cycle control system and relate them with cancer
- CO 5. Illustrate various signaling pathways and its components involved in maintaining cellular homeostasis by controlling cellular proliferation, growth, cell death, and cellular motility
- CO 6. Explain the methods of studying cell structure, function and activity.

Course Outcomes (COs)

Course Title & Code: Principles of Molecular Genetics (BTD502A)

After undergoing this course students will be able to:

- CO-1. Illustrate the structure and organization of the genetic material
- CO-2. Classify the mobile genetic elements
- CO-3. Summarize the various alterations in the genetic composition that lead to disease
- CO-4. Compare mechanisms involved in the genetic recombination and sex determination
- CO 5. Outline the various techniques applied in the study of molecular genetics
- CO 6. Apply the concepts of genetic recombination for gene mapping


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Course Outcomes (COs)

Course Title & Code: Biological Chemistry (BTD503A)

After undergoing this course students will be able to:

- CO-1. Demonstrate a broad knowledge of the fundamental introductory concepts of Chemistry and Biology
- CO-2. Describe the structures and functions of amino acids and proteins, and to characterize these at the molecular level
- CO-3. Explain the chemistry and functions of enzymes in order to address its catalytic activity, the process of regulation and inhibition
- CO-4. Describe the structures and functions of carbohydrates and lipids, and its metabolic importance in biological system
- CO 5. Enumerate the structure and chemistry of DNA and RNA, and its functional significance and metabolic importance in living organism
- CO 6. Demonstrate proficiency in developing relevant biochemical questions and answer those questions with critical analysis and interpretation.

Course Outcomes (COs)

Course Title & Code: Concepts of Microbiology (BTD504A)

After undergoing this course students will be able to:

- CO-1. Identify the differences between traditional and molecular approaches to taxonomy
- CO-2. Describe the cell morphology of gram positive, gram negative, archea and mycoplasmas
- CO-3. Demonstrate the phases of microbial growth curve and determine the relation to generation time
- CO-4. Differentiate the general characteristics , structure and reproduction of eukaryotic microorganisms
- CO 5. Compare and contrast the commons methods used for culture in the clinical laboratory for viruses that infect humans
- CO 6. Explain the methods of strain improvement for the production of economically important microbial products

Course Outcomes (COs)

Course Title & Code: Practical I: Cell Biology & Molecular Genetics (BTL501A)

After undergoing this course students will be able to:

- CO-1. Describe and carry out basic cell culture and microscopy
- CO-2. Evaluate cellular processes that occur in and between cells
- CO-3. Describe and explain processes for the characteristics of living organisms
- CO-4. Explain cell-based methods used to expand understanding of cell biology
- CO 5. Experiment with model organisms (Drosophila) in genetics
- CO 6. Demonstrate significant genetic concepts via experimentation



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Course Outcomes (COs)

Course Title & Code: Practical II: Microbiology & Biochemistry (BTL502A)

After undergoing this course students will be able to:

- CO-1. Perform an estimation of the concentration of bio-molecules from an unknown sample
- CO-2. Isolate and characterize the colony morphology of bacterial strains by staining and biochemical tests
- CO-3. Isolate enzyme from different sources, and estimate its specific activities
- CO-4. Production and estimation of byproducts from various bacterial strains.
- CO 5. Evaluate the quality of water by BOD and MPN test
- CO 6. Perform enzyme kinetic studies to characterize its molecular behavior

Course Outcomes (COs)

Course Title & Code: Biostatistics (BTD505A)

After undergoing this course students will be able to:

- CO-1. Explain the importance of data collection and its role in determining scope of inference
- CO-2. Demonstrate an understanding of the central concepts of modern statistical theory and their probabilistic foundation
- CO-3. Explain the use, and interpret results of, the principal methods of statistical inference and design
- CO-4. Explain the results of statistical analyses accurately and effectively
- CO 5. Enumerate an appropriate use of statistical software
- CO 6. Demonstrate the use of mathematical and statistical theory underlying the application of biostatistical methods; use and interpret results from specialized computer software for the management and statistical analysis of research data

Course Outcomes (COs)

Course Title & Code: Immunology & Immunotechniques (BTC501A)

After undergoing this course students will be able to:

- CO-1. Explain the structure, properties and functions of antigens, antibodies, B cells, T cells, APC, MHC molecules, cytokines, surface receptors, haptens and adjuvants.
- CO-2. Compare and contrast primary and secondary immune response, innate and acquired immune response, origin, maturation and general function of B and T lymphocytes, humoral and cell mediated immunity.
- CO-3. Describe the mechanisms of antigen processing, hypersensitivity reactions, consequences of autoimmune disorders, immunity to infections.
- CO-4. Evaluate different types of immune assay based on the principles of antigen-antibody reactions, cell proliferation assays, cytotoxicity assays
- CO 5. Illustrate the importance and application of molecular mechanisms of immune responses in therapeutic approaches.


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Course Outcomes (COs)

Course Title & Code: Molecular Biology and rDNA Technology (BTC502A)

After undergoing this course students will be able to:

- CO-1. Enumerate the processes of DNA replication, repair and recombination to maintain the integrity of DNA and chromosomes
- CO-2. Differentiate the tools and techniques used in recombinant DNA technology
- CO-3. Compare and contrast the process of prokaryotic and eukaryotic gene expression
- CO-4. Illustrate the complex mechanism behind eukaryotic and prokaryotic gene regulation
- CO 5. Evaluate the methodologies involved in in-vitro construction of gene libraries
- CO 6. Explain creative use of modern instrumentation and technologies for manipulation of genomic sequences

Course Outcomes (COs)

Course Title & Code: Bioinformatics (BTD506A)

After undergoing this course students will be able to:

- CO-1. Explain the use of bioinformatics in addressing a range of biological questions
- CO-2. Justify how bioinformatics methods can be used to relate sequence, structure and function
- CO-3. Enumerate the technologies for modern high-throughput DNA sequencing and their applications
- CO-4. Describe principles and algorithms of pairwise and multiple alignments, and sequence database searching
- CO 5. Explain how evolutionary relationships can be inferred from sequences (phylogenetics)
- CO 6. Explain the 3-D structure of protein, and its interaction with different ligands to draw structure-function relationship

Course Outcomes (COs)

Course Title & Code: Plant and Agricultural Biotechnology (BTC503A)

After undergoing this course students will be able to:

- CO-1. Outline plant tissue culture techniques and applications
- CO-2. Illustrate the tools involved in plant genetic engineering
- CO-3. Explain the role of genetic modification in improving crops
- CO-4. Classify the genetic markers applied in genetic engineering of plants
- CO 5. Summarize technologies involved in improvisation of post-harvest produce maintenance
- CO 6. Utilize biotechnological methods for maintenance of soil quality and crop health



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Course Outcomes (COs)

Course Title & Code: Practical III: Molecular Biology & Immunology (BTL503A)

After undergoing this course students will be able to:

- CO-1. Isolate and characterize DNA and Plasmids for molecular weight, restriction and ligation
- CO-2. Expertize in PCR and RAPD techniques for quantification of DNA
- CO-3. Acquire hands-on experience on gene cloning, protein expression and detection.
- CO-4. Perform cell culture and counting of immune cells and comment
- CO 5. Perform assays to assess the interaction and quantification of antigen and antibody
- CO 6. Perform experiments used to purify immunoglobulins from serum sample

Course Outcomes (COs)

Course Title & Code: Practical IV: Bioinformatics (BTL504A)

After undergoing this course students will be able to:

- CO-1. Analyze public database to study gene sequence through several online program
- CO-2. Demonstrate a Phylogenetic relationship between homologous, and non-homologous gene
- CO-3. Explain the sequence (nucleotide and amino acid) similarity and diversity through BLAST analysis
- CO-4. Develop a 3-D model of protein from primary structure and its energy minimization, and validation
- CO 5. Analyze a protein ligand interaction to study its structure-function relationship through molecular docking
- CO 6. Design a PCR primer and test an online PCR to check the validity of the primer

Course Outcomes (COs)

Course Title & Code: Research Methodology (BTD507A)

After undergoing this course students will be able to:

- CO-1. Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research
- CO-2. Demonstrate the application and utility of the Systematic approach and out of the box thinking concepts for research to be effective
- CO-3. Demonstrate the procedures outlined for a systematic Literature Review
- CO-4. Analyze and prepare well structured research proposal and research paper invoking clearly outlined principles

Course Outcomes (COs)

Course Title & Code: Animal Biotechnology (BTC504A)

After undergoing this course students will be able to:

- CO-1. Comprehend the fundamental concepts of animal cell culture, and its importance.
- CO-2. Illustrate stem cell culture emphasizing its application in tissue engineering
- CO-3. Discuss the significance of transgenes is with reference to animal models

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- CO-4. Explain the principles and applications of animal cloning and gene therapy
- CO 5. Discuss on the ethical concerns on animal biotechnology principles and applications

Course Outcomes (COs)

Course Title & Code: Practical V: Plant and Animal Biotechnology (BTL505A)

After undergoing this course students will be able to:

- CO-1. Describe and carry out basic preparations for plant and animal cell culture
- CO-2. Maintain cell cultures in proper aseptic conditions
- CO-3. Describe and explain processes for the characteristics of cultured cells
- CO-4. Characterize function of cultured cells
- CO 5. Identify species with standard molecular biology approaches
- CO 6. Demonstrate significant functions of plant and animal cells under different stress conditions

Course Outcomes (COs)

Course Title & Code: Entrepreneurship Skill Development (BTM501A)

After undergoing this course students will be able to:

- CO-1. Outline the basic concepts in entrepreneurship, identification of opportunities, business evaluation and analysis.
- CO-2. Conduct a market-analysis, a distribution- and sales analysis, as well as a marketing plan
- CO-3. Illustrate the differences in issues and challenges in science-based industries related to entrepreneurship and innovation
- CO-4. Identify the own personal entrepreneurial potential, ability, and competences
- CO 5. Create and execute marketing, biotechnology development and strategic plans that integrate technological development with evolving international customer requirements
- CO 6. Compose and write a business plan offering a convincing presentation of a biotech venture. The element of the business plan should reflect skillful application of theories and tools from the course

Course Outcomes (COs)

Course Title & Code: Group Project (BTP501A)

After undergoing this course students will be able to:

- CO-1. Work in a team and undertake a project in the area of Genomics, NGS, Clinical data analysis, Critical analysis of papers by using analytical research approach
- CO-2. Apply Biotechnology principles and techniques for executing the project
- CO-3. Apply appropriate research methodology while formulating a project
- CO-4. Define Specifications, Synthesize, Analyse, Develop and Evaluate a project
- CO 5. Develop a report which explains the project and make a presentation and document the work



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Course Outcomes (COs)

Course Title & Code: Stem Cell and Regenerative Medicine (BTE501A)

After undergoing this course students will be able to:

- CO-1. Identify characteristic features of Stem cells, their origin, maintenance and regulation.
- CO-2. Explain the properties of stem cells and their therapeutic implication.
- CO-3. Illustrate the clinical uses of stem cells as an alternative treatment modality.
- CO-4. Explain the pros and cons of stem cell treatment in cancer therapeutics
- CO 5. Exemplifying the methods of bio-amplification of stem cells for therapeutic use
- CO 6. Focus on building perspective on the future of stem cell therapy and regenerative medicine.

Course Outcomes (COs)

Course Title & Code: Synthetic Biology (BTE502A)

After undergoing this course students will be able to:

- CO-1. Explain how naturally occurring organisms regulate the expression of their genes
- CO-2. Describe how the regulation of the genes and properties of gene products can be altered with synthetic biology methods
- CO-3. Justify how synthetic biology alters the properties of the cell or the organism
- CO-4. Develop a scientific approach to the planning, execution, reporting and interpretation of advanced projects with the aim at creating replicating systems with new properties that can be regulated, and to critically analyse the results and generate testable hypotheses from these experiments
- CO 5. Develop a critically analytical skill, present and defend scientific literature in synthetic biology, including practical applications such as metabolic engineering
- CO 6. Develop a scientific approach to entirely synthesize Escherichia coli with a recoded genome

Course Outcomes (COs)

Course Title & Code: Medical Biotechnology (BTE503A)

After undergoing this course students will be able to:

- CO-1. Outline the biotechnological tools in disease diagnosis
- CO-2. Distinguish various molecular therapeutic approaches to diseases
- CO-3. Explain the role of microbes in therapeutic applications
- CO-4. Summarize the recent trends in medical biotechnology
- CO 5. Illustrate strategies and techniques used in drug development
- CO 6. Discuss the importance of clinical research in medicine


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Course Outcomes (COs)

Course Title & Code: Genomics and Proteomics (BTE504A)

After undergoing this course students will be able to:

- CO-1. Explain the genome organization in Eukaryotes.
- CO-2. Explain the various techniques of gene manipulation for research applications
- CO-3. Evaluation and application of gene manipulation techniques.
- CO-4. Compare the different methods of estimating and separating protein
- CO 5. Illustrate Protein manipulation techniques and its application in research
- CO 6. Explain clinical significance of Gene and protein manipulation technique

Course Outcomes (COs)

Course Title & Code: Biosafety Regulation, Bioethics and IPR (BTE505A)

After undergoing this course students will be able to:

- CO-1. Explain different types of intellectual property rights in general and protection of products derived from biotechnology research and issues related to application and obtaining patents.
- CO-2. Gain knowledge of biosafety and risk assessment of products derived from recombinant DNA research and environment release of genetically modified organisms, national and international regulations.
- CO-3. Describe ethical aspects related to biological, biomedical, health care and biotechnology research.

Course Outcomes (COs)

Course Title & Code: Downstream Processing (BTE506A)

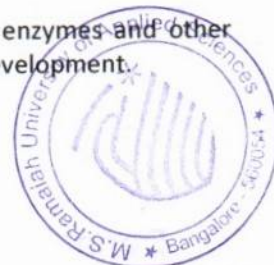
After undergoing this course students will be able to:

- CO-1. Describe the principles that underlie major unit operations used in downstream processing of biotechnological and biopharmaceuticals.
- CO-2. Discuss a suitable scheme of bioproduct separations based upon the molecular characteristics of the product and other process criteria
- CO-3. Demonstrate the suitable downstream approaches comprising of new concepts and emerging technologies that are likely to benefit product recovery for small and large scale in the future.
- CO-4. Explain the principles of various types of high resolution techniques for valuable product purification.
- CO 5. Design and formulate effective strategies of downstream processing based on characteristics of biomolecules and to learn the various techniques of product capturing, isolation, purification and polishing
- CO 6. Develop and formulate methods to meet the need of pure proteins, enzymes and other valuable products related to biopharmaceuticals, clinical research and development.


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Course Outcomes (COs)

Course Title & Code: Drug Design and Development (BTE507A)

After undergoing this course students will be able to:

- CO-1. Describe key principles of pharmacognosy and natural products and their role in shaping the pharmaceutical industry, including Traditional, Complementary and Alternative Medicines
- CO-2. Explain the role of synthetic chemistry in the development of pharmaceutical agents; and the modification of chemical structures to develop new drug molecules
- CO-3. Explain the chemical structure of a pharmaceutical agent and determine the chemical group/s responsible for a given biological effect
- CO-4. Delineate the modern and innovative discovery of biopharmaceuticals as it relates to today's healthcare and future trends in modern drug discovery globally
- CO 5. Develop an understanding of drug targets as a recognition site for pharmaceutical agents; how the chemical structure of a substance influences interaction with a drug target; and the identification of new drug targets for future drug discovery
- CO 6. Develop key concepts of the drug discovery process including regulatory affairs, patenting, registration and marketing in a global context

Course Outcomes (COs)

Course Title & Code: Biotherapeutics (Elective) (BTE508A)

After undergoing this course students will be able to:

- CO-1. Conceptualize biopharmaceuticals and pharmaceutical biotechnology, Biopharmaceuticals: current status and future prospects, generic and branded biopharmaceuticals
- CO-2. Explain formulation of biotherapeutics, formulation recipients: solubility enhancers, anti aggregating agents, buffers, cryoprotectants, antioxidants and preservatives
- CO-3. Conceive the responsive or smart drug delivery system
- CO-4. Describe Novel drug delivery systems for biopharmaceuticals (rate controlled and site specific), Nanotechnology based miniaturization of biopharmaceuticals and therapeutics, peptides
- CO 5. Justify discovery of protein or peptide based therapeutics: In-silico, pharmaco-informatics. Pre-clinical toxicity assessment, Clinical trial phases and design, clinical data management

Course Outcomes (COs)

Course Title & Code: AI in Health Care (BTE509A)

After undergoing this course students will be able to:

- CO-1. Demonstrate the understanding and knowledge regarding to the needs of AI in healthcare
- CO-2. Describe the possibilities of applications of AI to healthcare
- CO-3. Describe the ethical issues related to AI in health care sector
- CO-4. Explore methods to overcome the challenges of AI in the healthcare domain; and ways in which AI will support and assist towards better healthcare


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Course Outcomes (COs)

Course Title & Code: Molecular Carcinogenesis (BTE510A)

After undergoing this course students will be able to:

- CO-1. Classify cancer types and the causal agents
- CO-2. Relate particular chromosomal aberrations that underlie specific cancer types
- CO-3. Summarize the types of genetic mutations that are key to causing cancer
- CO-4. Explain the processes involved in the initiation and progression of cancer
- CO 5. Outline the current developments in cancer diagnostics and therapy
- CO 6. Distinguish molecular pathways which form suitable targets for therapeutic applications

Course Outcomes (COs)

Course Title & Code: Dissertation and Publication (BTP502A)

After undergoing this course students will be able to:

- CO-1. Critically review scholarly literature collected from various sources for the project purpose and formulate a research problem
- CO-2. Prepare and present a research proposal
- CO-3. Conduct research to achieve research objectives
- CO-4. Propose new ideas/methodologies or procedures for further improvement of the research undertaken
- CO 5. Create research document and write research papers for publications
- CO 6. Defend the research findings in front of scholarly audience



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